U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1229 rev. Aug. 1925

UTILIZATION OF ALFALFA

HEREIN the uses of alfalfa are set forth, particularly its use as a forage crop, and suggestions are offered that may be helpful in making its utilization more efficient and more generally satisfactory.

Recent experiments indicate that larger yields of hay result and stands are maintained in better condition when the cutting is delayed until the alfalfa plants are in full bloom.

Alfalfa hay is equal, if not superior, in palatability and feeding value to hay made from any other crop.

As a pasture crop alfalfa must be grazed with care; otherwise the stands may be seriously injured, if not destroyed. Hogs do exceedingly well on alfalfa pasture and are less likely than other animals to injure the stand.

As a soiling crop alfalfa is very satisfactory for cattle, but if the stands are to be maintained the fields should be cut no more frequently nor in an earlier stage of development than when hay is to be made.

The straw that is left after threshing a seed crop is considered worth one-third to one-half as much as alfalfa hay for feeding purposes.

Alfalfa makes good silage if thoroughly packed to exclude the air, but experience indicates that as ordinarily put up on the farm this silage will not keep as long as corn silage.

Factors which should be carefully considered by a prospective entrant into the alfalfa-meal industry are the cost of the plant, the availability and cost of hay, the shipping and marketing facilities, the availability of labor, and the climatic conditions.

In undertaking the manufacture of alfalfa meal on a commercial scale there should be available under normal conditions for buildings and machinery a working capital of $15,000 to $40,000.

There are two general types of alfalfa mills. One reduces the hay to meal by breaking or grinding and the other by cutting.

The feeding value of alfalfa is not increased by grinding. The advantages of meal are that it is fed with less loss and the shipping charges are less as compared with hay.

Several mills located in the big cities of the Middle West operate plants where alfalfa meal is mixed with molasses and various concentrates. The feeding value of these mixtures is dependent upon the ingredients they carry.

Washington, D. C. Issued December, 1921; revised August, 1925

UTILIZATION OF ALFALFA

R. A. OAKLEY, *Senior Agronomist*, and H. L. WESTOVER, *Associate Agronomist*, *Office of Forage-Crop Investigations, Bureau of Plant Industry*

CONTENTS

A NEARLY PERFECT FORAGE

NO FORAGE CROP cultivated in the United States is utilized successfully in so many ways as alfalfa. It is more nearly a perfect forage than any other crop grown in this country. As hay it is unsurpassed for general feeding. As pasture it has a high carrying capacity and produces large gains. As a soiling crop it is valuable with proper handling. It makes excellent silage and when ground into meal is a good and easily handled feed. Alfalfa is so highly regarded as forage that attempts have been made to introduce it into the realm of human food and medicine. There, however, it is out of place. It can not compete as food with other staple crops, and, so far as known, it possesses no special medicinal properties.

Alfalfa is not alone valuable as a forage crop but also produces a favorable effect on the succeeding crops, and because of this is generally regarded as a soil improver. It does not lend itself well to short rotations, but, other conditions being favorable, good yields of intertilled crops are produced on fields that have been in alfalfa for a few years.

MAKING ALFALFA HAY

A great proportion of the alfalfa of the country is utilized as hay. The number of cuttings obtainable from a field in a year depends upon the variety and the length of the growing season and varies from eight, or occasionally more, in the extreme Southwest, to two, or sometimes only one, in the northern and semiarid sections. From 30 to 40 days of good growing weather are usually required to produce sufficient growth for a hay crop.

TIME OF CUTTING ALFALFA

The proper time to cut alfalfa is a subject upon which there is conflicting opinion. Chemical analyses have shown alfalfa cut in early bloom to be slightly higher in protein than that cut when more

mature. Certain farm animals, such as hogs and cattle, have a preference for it when cut at the earlier stages. Partly because of these facts and also because it was believed that the more frequent cuttings gave larger total yields, the earlier writers on alfalfa recommended cutting just before the flowers appeared.

Experiments soon proved that such early cuttings reduce the longevity of the stand, and while yields are usually greater the first season, they are much less over a period of years. The later recommendation was that the alfalfa be cut when the basal shoots were 1 or 2 inches long, or when the plants are one-tenth in bloom. The two guides as to proper stage for cutting seem to be needed, as basal shoots usually make little growth in dry weather and blossoms are slow to appear during wet periods.

In view of recent experiments, particularly those conducted by the Kansas Agricultural Experiment Station, it would seem that cutting at a later stage is generally more satisfactory. That station for several years compared cutting at four stages, viz, in bud, one-tenth in bloom, full bloom, and when seed pods were forming. In feeding

FIG. 1.—Hay caps used in curing alfalfa

value the earliest cutting was highest, but the stand was practically destroyed in one season. Cutting when one-tenth in bloom gave less hay than when in full bloom; moreover, grass and weeds soon began to appear in the plat. Cutting when the seed pods were forming gave less hay than earlier cuttings, but the stand was not injured. No damage resulted from cutting the basal shoots, in spite of the fact that writers generally have emphasized the necessity of harvesting before such shoots are tall enough to be cut by the mower. Similar results have been obtained in experiments conducted by the Wisconsin Agricultural Experiment Station and the United States Department of Agriculture.

Where winterkilling is a factor the last cutting of the season should take place early enough to allow for a growth of at least 6 to 8 inches for winter protection; otherwise serious injury is likely to result.

In the Great Plains region, where the rainfall is rather limited, stands of alfalfa are sometimes seriously depleted when the first cutting is delayed until the plants are nearly through blooming. The injury is likely to be more serious where a second cutting is made or

where the alfalfa is left for seed. This is particularly true in dry seasons when the soil does not contain sufficient moisture to produce any appreciable growth after cutting. It must be borne in mind that cutting is harmful rather than beneficial to the plants.

CURING ALFALFA

The methods of harvesting alfalfa for hay vary considerably in different parts of the country. The aim is to get the hay into the stack or barn with as large a proportion of the leaves as possible. The best way to do this is to let most of the curing take place in the cock. However, this system entails a greater amount of labor, and as more time is required the hay is subjected to greater danger of damage by rain. When a farmer has a large acreage to handle it becomes necessary to do the work in the most rapid and economical manner possible. In most of the big alfalfa-growing sections of the West rains are less frequent at harvest time and curing presents fewer difficulties than in the East. In good drying weather the general practice in the West is to mow in the morning, rake in the afternoon or on the following morning as soon as the dew is off, and then bunch with the rake or leave the hay to cure in the windrow. If the growth is not too heavy the hay should be ready to stack by the second afternoon. In the East, where rains are of such frequent occurrence, it is sometimes necessary to do much of the curing in the cock; but where the weather promises to be fair for two or three days it is usually advisable to hasten the process by doing much of the curing in the windrow even at the sacrifice of some of the leaves. If the hay is exposed to unfavorable weather for several days even though cocked, the resulting loss is very likely to be greater than would result from shattering by more rapid curing.

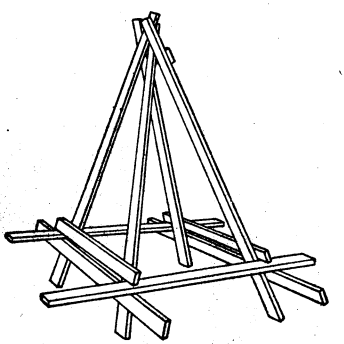

FIG. 2.—A curing frame that is sometimes used in curing hay in humid sections

To hasten the drying of the hay and avoid damage by rain, several devices are used in humid sections. Hay caps, ordinarily consisting of a piece of canvas 3 feet square with a weight at each corner, are of considerable assistance in making a good quality of hay during unfavorable weather (fig. 1). To what extent their use is economical can not be stated definitely. Various forms of curing frames or tripods have been successfully used (fig. 2). One of these frames is described in detail in Farmers' Bulletin 677, entitled "Growing Hay in the South for Market."

Another device that is sometimes used is the curing truck, which is quite similar to the ordinary hayrack. It is approximately 12 feet long and 7 feet wide and will hold from 1,500 to 2,000 pounds of cured hay. The rack is supported by two 16 to 20 inch wheels placed about 4 feet from the rear end of an A-shaped frame. The front end is supported by a 6 by 8 inch wooden block of sufficient length to hold the truck level when it is not being moved. The truck is moved

by means of a 2-wheel running gear similar to the front running gear of a low-wheeled wagon. When the hay is nearly in the condition in which it ordinarily goes into the cock it is put on the truck to finish curing.

The objection to all these devices is the additional labor and cost involved, and the economy of using them is questionable where labor is scarce and materials high. Where labor is plentiful and materials cheap the better quality of the hay may compensate for the additional expense.

STORING AND STACKING

The least loss of hay results when alfalfa is stored in the barn. It is frequently stated that the loss in hay stacked in the open is 10 per cent greater than in that stored in the barn. Much of this loss can be eliminated, however, by greater care in stacking and by covering the stack properly.

FIG. 3.—A well-built alfalfa haystack

In the semiarid and arid sections of the West the losses due to weathering are much less than in the more humid sections. There many of the stacks are very carelessly built and are usually left uncovered. Notwithstanding the favorable climatic conditions, however, the loss in hay that remains in the stack for any considerable time is usually sufficiently heavy to more than equal the cost of time and labor involved in building a good stack.

Under humid conditions much greater care must be given to the building of stacks; otherwise the losses will be heavy. As the spoilage is proportionately less in large stacks the stacks should contain as much hay as practicable, and in order to shed water satisfactorily should be somewhat larger at the height of 6 feet than they are at the ground (fig. 3). The saving involved will ordinarily justify the additional cost of a protective covering, such as canvas, boards, or corrugated sheet iron (fig. 4). Where some such protection is not available the stack should be capped with grass

hay, freshly cut slough grass or Sudan grass. A load of green alfalfa placed on top will, on drying, form a good protection to the stack.

Alfalfa should not be put in the barn too green, as, like timothy, clover, or other hay, it is likely to heat, and in extreme cases to burn. However, the danger from spontaneous combustion can be lessened by the use of a boxlike ventilator, such as is shown in Figure 5. This ventilator is 12 to 15 inches square and may be of any length desired. The corners are 2 by 4s and the crosspieces 1 by 3s placed close enough together to keep the hay from falling through and blocking the air passage. Braces are placed at intervals to prevent the box from collapsing under the pressure of the hay. The ventilators are usually placed across the mow at intervals of 7 or 8 feet. Where

FIG. 4.—Stacks covered with corrugated sheet iron. These stacks are poorly built, but the covering will reduce the spoilage

the mow is wide they are built in sections for convenience in handling. Figure 6 shows two of these ventilators in place.

BALING ALFALFA

Of the alfalfa that is baled, by far the greater part is baled from the stack or mow after the hay has gone through the sweat. When this stage has been passed there is practically no further loss, and on the basis of weight it makes little difference whether the hay is marketed immediately or several months later. However, in the arid and semiarid districts considerable baling is done from the windrow or cock. Though this practice is the most economical because of the smaller amount of handling required, it is generally less satisfactory from the feeder's standpoint. This is because the alfalfa is usually so dry before baling that it loses many leaves, and the feeding value of the hay is thereby reduced.

BROWN HAY

When alfalfa is stacked before it is properly cured, that is, while it is only partially wilted or more or less green, chemical actions take

place which result in changing the character of the hay. These changes involve change in color from normal green to shades of brown or black. They are for the most part the same or similar to those that take place in the silo. Their nature and extent depend very largely upon the percentage of moisture in the material when it is put into the stack or mow and the compactness with which it is stacked. A high percentage of moisture and relatively loose compacting or stacking in a small stack bring about charring or molding, resulting in a black or moldy product unfit for feed. If, however, the uncured hay is stacked properly with the requisite percentage of moisture, what is known as brown hay, having a pleasant odor, is produced.

Much, if not most, of the brown hay is the result of accident rather than of definite intention; in fact, in a great many cases definite efforts to make brown hay have failed, and much loss has resulted.

The advantages claimed for brown hay are greater feeding value and the reduction of loss as a result of unfavorable weather for curing. As to the former, there are differences of opinion. Some farmers report excellent results from feeding brown hay; others have less satisfactory or adverse results. Good brown hay is very palatable to stock, but that it is superior to good field-cured hay in feeding value is very doubtful. Furthermore there is evidence of actual loss of dry matter in making brown hay, even though the best methods are used. The experiments conducted by the Kansas Agricultural Experiment Station show this quite clearly and also that the loss is apparently increased with the length of time the hay is left in the stack and the degree of fermentation or organic change which it undergoes. The feeding tests with beef steers made by the Kansas Agricultural Experiment Station, in which brown and black alfalfa hay were tested in comparison with bright field-cured hay, indicate that good brown hay is as valuable as good green hay and that either is much superior to black hay.

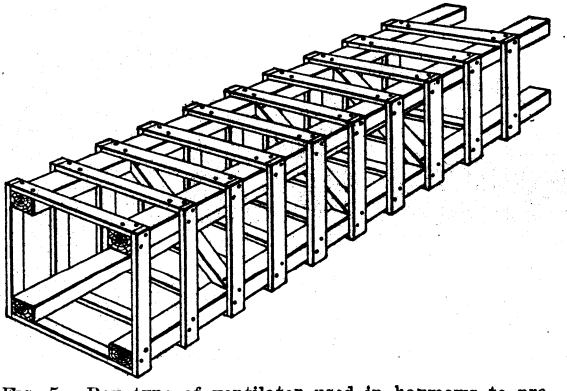

FIG. 5.—Box type of ventilator used in haymows to prevent spontaneous combustion

The Wyoming Agricultural Experiment Station states that as a result of actual tests many farmers have satisfied themselves that brown hay is more palatable than bright or green field-cured hay and superior to it in feeding value for cattle and sheep. However, it is regarded by that station as being too dusty for horses.

From the reports at hand it is fairly concluded that good brown alfalfa hay is equal or somewhat superior in palatability to good field-cured hay, but not superior to it in feeding value.

Granted that the process by which brown hay is made does not make the hay more valuable, nevertheless the method involved would be important provided it could be depended upon for saving hay in humid climates, where satisfactory field curing is difficult. Such a method would enable the farmer to make good hay from his crop even if it contained a relatively high percentage of moisture.

Available experiments indicate that if external moisture is present on alfalfa—that is, if it is wet with rain or heavy dew—it can not be made into a good quality of brown hay. However, there seems to be no positive evidence in support of this contention. Because of the danger from spontaneous combustion, farmers are advised not to attempt to make brown hay in their barns or mows. If they

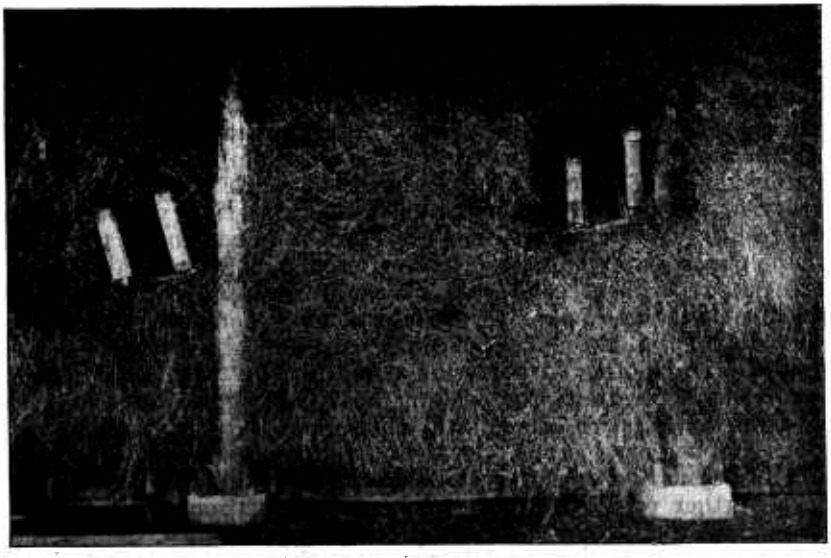

FIG. 6.—Ventilators in place in a hay barn

wish to make it, they should use good-sized stacks, since it is difficult to bring about proper conditions for curing in small stacks.

FEEDING ALFALFA HAY

Well-cured alfalfa is more readily eaten by all classes of farm animals than any other kind of hay. In feeding value it excels hay made from any of the grasses, and though chemical analyses do not show it to be any higher in the important constituents than certain other of the legumes, such as cowpeas, soybeans, and clover, the fact that alfalfa is generally more palatable gives it a somewhat higher feeding value. Several experiments have shown that good alfalfa hay is nearly, if not quite, equal to wheat bran, and when it is included in a ration the feed bill is reduced by doing away to a considerable extent with the necessity of purchasing protein feeds in the form of high-priced concentrates.

Practically all farm animals show a preference for alfalfa hay cut in the early stages of growth, but this does not mean that such

hay is always the best for feeding. On the contrary, certain animals, horses and mules in particular, do much better on hay made when the alfalfa is in full bloom, as the hay made at the early stages may be somewhat too laxative. Hogs and poultry can not handle such coarse material, and unless the alfalfa is cut while still young and tender considerable wastage in feeding will result.

ALFALFA HAY FOR BEEF CATTLE

Alfalfa probably is the best roughage for fattening cattle. It is also very valuable for young stock. Fed alone, it is more than a maintenance ration, but it is wasteful to make it the only feed, as its narrow nutritive ratio results in an uneconomical use of protein. Cases of bloat have been reported from feeding alfalfa hay, but they are uncommon and generally traceable to overfeeding or to moldy or spoiled hay.

In comparing the value of certain roughages for wintering calves the North Platte experiment substation found that alfalfa hay gave much larger gains than prairie or sorghum hay. Half and half alfalfa and prairie hay or alfalfa and sorghum hay gave approximately the same gain as alfalfa alone, but much greater gains than either of the other roughages alone. In wintering yearling steers the results were quite similar; therefore it is concluded that some of the cheaper roughages can be used economically with alfalfa.

In an experiment conducted by the Nebraska Agricultural Experiment Station comparing various combinations of corn, alfalfa, corn silage, and cottonseed meal, the corn and alfalfa gave the best results. In another experiment conducted by the same station, comparing 11 rations for feeding beef calves, the one composed of alfalfa hay, corn silage, and corn gave the best and cheapest gains and the most profit. In these experiments it was shown that alfalfa hay as a source of protein was cheaper than cottonseed meal. In a further comparison of rations a combination of alfalfa and silage gave the largest and most profitable gains.

The Arizona Agricultural Experiment Station found that alfalfa hay as a supplement to silage was more satisfactory than cottonseed meal.

The Kansas Agricultural Experiment Station found that the profit was much greater in feeding steers with corn-and-cob meal and alfalfa hay than in feeding the meal with sorghum hay.

In numerous experiments the addition of alfalfa to a ration for fattening cattle or for young growing stock has resulted in the production of cheaper, better, and more profitable gains. Compared with hay made from sorghum and the grasses, alfalfa hay without exception has given the best gains, but compared with hay made from clover and certain other legumes there does not seem to be any great difference in results, although in many cases the animals apparently find the alfalfa hay somewhat more palatable.

ALFALFA HAY FOR DAIRY COWS

Dairy cows require high-protein feeds to produce profitable flows of milk. These can be supplied by feeding nonleguminous roughage and various protein concentrates, but the latter are expensive and can be replaced to a considerable extent by various legumes. Alfalfa

hay is especially suitable for this purpose. It is palatable, very easily digested, and has a cooling and laxative effect. The quantity of alfalfa hay that a cow will eat varies, but it is commonly estimated that a dry cow will eat 20 to 25 pounds a day and a milking cow 25 to 30 pounds.

The Kansas Agricultural Experiment Station found that butterfat could be produced somewhat more cheaply where alfalfa hay was included in the feed than where the rations were balanced with concentrates. In a comparative feeding test the Illinois Agricultural Experiment Station found alfalfa hay a little superior to wheat bran, while the Pennsylvania and Tennessee stations found it somewhat inferior. The Nebraska Agricultural Experiment Station concluded as the result of experiments that good chopped alfalfa hay was equal to wheat bran.

In California it is a common practice to feed cows almost entirely on alfalfa, either pasture or hay. Though an experiment conducted at the California Agricultural Experiment Station did not show any increased profit by the addition of barley to the ration, still it is believed that, in general, the practice is economical and has a favorable influence on the condition of the cows and calves.

The Ontario Agricultural College and Experimental Farm found that with alfalfa hay and silage a cow can maintain her milk flow on a very small corn-meal ration, and in cases of cows far advanced in lactation the meal ration may be omitted entirely without decreasing the milk flow.

In general when alfalfa replaces to a large extent the high-priced concentrates, the profits derived from milk and butter are increased. In all cases alfalfa has shown its superiority to grass hays. It is equal, if not superior, to hay made from any other legume, and the best alfalfa hay is only slightly inferior to wheat bran.

ALFALFA HAY FOR HORSES AND MULES

Both horses and mules are fond of alfalfa, and when discretion is used in feeding they thrive on it exceedingly well. Instances are on record where work has been performed on alfalfa hay alone, but such a practice is not only wasteful but likely to result injuriously to the animals. To get the full benefit from the protein in the alfalfa, a small grain ration should be fed.

In a comparative test of alfalfa, Johnson grass, Bermuda grass, timothy, and lespedeza for mules, the Mississippi Agricultural Experiment Station found that alfalfa stood first in feeding value and cheapness of gains. As a result of experiments the Kansas Agricultural Experiment Station found that corn and alfalfa when properly fed gave the cheapest ration for work horses. Alfalfa hay proved to be more valuable as roughage than prairie or timothy hay, reducing the cost of the daily ration 25 to 35 cents when fed with corn and oats. The Illinois Agricultural Experiment Station reports that less grain was required with alfalfa than with timothy to prevent farm horses from losing weight. At the Utah Agricultural Experiment Station it was shown that horses could be maintained at less cost and in better condition on alfalfa than on timothy.

These experiments and others show conclusively that alfalfa is one of the best roughages for horses, in spite of the prejudice against

feeding it that exists among farmers. Numerous cases are on record where alfalfa hay has formed for years the major portion of the ration for work horses without injurious effect. In most cases harmful results can be traced to overfeeding or to using spoiled hay. To feed most economically, horses that are at work should have 1 pound of hay a day per 100 pounds of live weight. The first cutting, being considerably coarser, is better for horses than the subsequent cuttings, which are inclined to be "washy."

Authentic instances are reported where horses and mules have eaten the stems and left the leaves of good alfalfa hay, but a satisfactory explanation of this has never been offered.

ALFALFA HAY FOR SHEEP

Alfalfa hay is an excellent feed for sheep, either for breeding or fattening stock. Ordinarily the coarse and stemmy first cutting is not as good for sheep as the subsequent cuttings.

The New Mexico Agricultural Experiment Station was able to produce mutton of a quality suitable for local markets on alfalfa hay alone, but the addition of a little grain gave larger returns per acre of alfalfa hay, the cheapest gain being made on alfalfa hay and one-fourth of a pound of corn a day. More rapid gains, a shorter feeding period, and a better product resulted from the addition of grain. The Illinois Agricultural Experiment Station found that the most rapid gains were made when the proportion of corn was as great as the lambs could consume. With cheap corn such a ration gave the cheapest gains, but it is concluded that in feeding for profit the feeder must be guided to some extent by the relative prices of corn and alfalfa hay in determining the proper proportion of each. The Kansas Agricultural Experiment Station has been able to carry breeding ewes through the winter almost exclusively on alfalfa hay.

In general, though sheep may be kept in a very good condition on alfalfa hay alone, the addition of a little grain is advisable, both for breeding animals and for those being fattened.

ALFALFA HAY FOR HOGS

Hogs are supposed to be so constituted that they can not economically digest dry hay or fodder, but there appears to be an exception to this in the case of alfalfa. Hogs do not eat alfalfa hay readily at first, but after becoming accustomed to it they relish a limited quantity, especially if it is made from plants cut at an early stage of maturity. However, as has previously been pointed out, there is danger of injuring the stand seriously by harvesting the alfalfa before it is well in bloom. To maintain a stand as long as possible it is necessary to sacrifice the palatability to some extent by delaying the cutting until a later stage.

Several State agricultural experiment stations have conducted experiments in feeding alfalfa hay to hogs. Practically all of them report very satisfactory results. In almost every case the addition of alfalfa hay to a grain ration reduced the cost of gains and improved the physical condition of the hogs. The North Dakota Agricultural Experiment Station found that when brood sows were

fed alfalfa hay the grain ration could be reduced from one-third to one-fourth. When a one-fifth to one-sixth ration of alfalfa hay was fed with grain, considerable saving was effected in fattening hogs. At the Nebraska Agricultural Experiment Station brood sows were wintered on good alfalfa hay alone, but the results were more satisfactory where the animals received 1 pound of corn for every 100 pounds of live weight. As a result of another experiment conducted at this same station, alfalfa as a source of protein gave cheaper gains than tankage. Of several rations for fattening hogs that were compared none was equal to corn and alfalfa in the ratio of 9 to 1. At the Kansas Agricultural Experiment Station it was found that the gain on corn meal alone was more costly than where the hogs received alfalfa hay in addition to corn.

In several instances steamed hay has been compared with dry hay, and the general conclusion is that while the former gives somewhat larger gains, the gains are not sufficient to justify the additional expense of steaming. Practically the same conclusions have been reached in comparing ground and chopped alfalfa hay with unchopped hay.

Alfalfa is an ideal feed for brood sows, and there is less trouble with swine diseases when liberal quantities are fed.

PASTURING ALFALFA

As far as palatability and carrying capacity are concerned, few plants excel alfalfa for pasturage. However, the crop should not be pastured the first year, and though it may be pastured lightly the second it is better to delay grazing until the third year, by which time the plants will have become more thoroughly established.

The advisability of pasturing alfalfa in the East at any time is open to question, as there is great danger of seriously injuring or destroying the stand unless extreme caution is used to avoid overpasturing, grazing at an improper stage of growth, or grazing when the land is wet or frozen. The danger does not seem to be as great west of the ninety-seventh meridian, although even here due consideration should be given to these various points. While close grazing is injurious to alfalfa at any time, it is especially harmful in the late fall, since it leaves the plants in poor condition to go into the winter and results in whole fields being destroyed. Horses, mules, and sheep are more likely to injure alfalfa than are cattle or hogs, since they have a tendency to graze so closely as to injure the crowns of the plants.

When alfalfa is grazed regularly and closely, plants die, the stand thins out, and weeds come in. This condition can be obviated to a considerable extent by dividing the alfalfa field into several smaller fields and grazing the stock on each in succession. When the alfalfa is ready to cut for hay, enough stock is turned in to eat down the crop in a few days and then transferred to another field. Sometimes a field becomes too nearly mature before it is reached in the regular rotation, and then it is necessary to cut the crop for hay. Under the system of alternate grazing and resting, good stands have been maintained much longer than when the fields were continuously pastured.

Because of the danger in most parts of the country, and particularly in the humid sections, of losses from bloat, the advisability of

pasturing alfalfa with sheep or cattle is open to question. This does not apply to horses, mules, or hogs, as no risk attends grazing them on alfalfa.

CATTLE ON ALFALFA PASTURE

All classes of cattle do exceptionally well when grazed on alfalfa, but there is always more or less danger of bloat attending this practice. The danger is greatest in humid sections, but bloat may occur in any section, even under irrigation in the West, where a dry climate prevails. Some farmers who have pastured cattle on alfalfa for years have met with no difficulty, whereas others under conditions apparently the same have sustained heavy losses. Just why this is so has not been satisfactorily explained; in fact, the conditions that cause bloat are not well understood. Generally, the danger from bloat seems to be greatest when the alfalfa is young and tender.

FIG. 7.—Dairy cows grazing on alfalfa

There are certain other conditions which experience seems to point to as inducing bloat, and as a result certain precautions are advised which it is thought will very greatly reduce the risk. Those generally recommended are: (1) Do not turn the cattle into the field when the alfalfa is wet with rain or dew; (2) let the animals feed on other forage, preferably hay, before turning them in on alfalfa; (3) allow the cattle to graze only a few minutes at a time until they have become accustomed to it, and then do not take them out of the field except for water; (4) sow some grass with the alfalfa, and have a patch of grass where the stock can graze on it at any time; (5) have a stack of hay or straw in the field, to which the cattle may have free access; and (6) have water and salt easily accessible to them.

If bloating occurs, there are various remedies that are more or less efficacious when employed in time. One commonly suggested is

to drench the animal with a pint of raw linseed oil to which is added 4 tablespoonfuls of turpentine. Another treatment recommended is to drench with a one-half per cent solution of formalin made by adding 1 tablespoonful of formalin to 1 quart of water. These remedies may afford relief in the early stages, but when the case is well developed it is rarely that an animal can be saved except by the use of a trocar. It is always advisable to call a veterinarian when symptoms of bloat first appear, as farmers do not ordinarily have trocars or other means of treatment and are not sufficiently experienced to handle serious cases.

Because of the danger of bloat, very few experiments have been conducted to determine the number of cattle a given area of alfalfa will carry, but it is generally estimated that 1 acre will support steadily two animals of approximately 900 pounds each for two months. The gains made by all classes of cattle on alfalfa pasturage, except where cases of bloat occur, are almost without exception highly satisfactory (fig. 7).

HORSES ON ALFALFA PASTURE

No other pasture is equal to alfalfa for horses and mules. Work stock keep in good flesh and work well when fed a small quantity of grain daily in addition to alfalfa pasturage. It is especially good for mares and their foals. The Kansas Agricultural Experiment Station found that to get the greatest growth and development in horses it is necessary to feed some grain with alfalfa pasturage until the animals reach maturity.

Liverymen are prejudiced against alfalfa pasture for horses because of its laxative effect, and many claim that it stimulates the kidneys unduly. However, numerous cases are on record where alfalfa pasture has formed the major portion of the ration for working animals for a considerable time with no injurious results, and instances have been reported where horses have performed heavy work during the summer on nothing but alfalfa pasture. However, such feeding is not recommended for draft or driving horses.

SHEEP ON ALFALFA PASTURE

Sheep are fond of alfalfa pasture and thrive on it if they do not bloat. The losses of sheep from bloat have been so great that in many parts of the country the practice of pasturing them on alfalfa has been discontinued. In the irrigated valleys of Arizona and California and some other sections of the West sheep are grazed regularly on alfalfa during the winters, but there are very few experimental data as to the carrying capacity per acre, the losses that may be expected, or the gains that can be depended upon.

The Colorado Agricultural Experiment Station, after collecting data from many large sheepmen, reached the conclusion that where the precautions that are recommended in pasturing cattle on alfalfa are followed, the loss of sheep can be kept down to 5 per cent, but where these precautions are not followed the losses usually run very high. This station recommended that only old ewes and their lambs be kept on alfalfa pasture, as they are less subject to bloat than young ewes or wethers. The carrying capacity of an acre is given

at eight ewes and their lambs, from the middle of April to the first of October.

In the published report, "The Work of the Belle Fourche Reclamation Project Experiment Farm in 1915," it is stated that in the alfalfa-grazing experiments with sheep no bloating occurred. It is further claimed that sheep are successfully grazed on alfalfa by local stockmen, particularly in the late summer and early fall.

HOGS ON ALFALFA PASTURE

In general, better results are obtained by pasturing alfalfa with hogs than with any other livestock. Hogs thrive on it and with proper precautions cause little injury to the stand. They do not trample the soil as much as heavier animals and therefore, even in

FIG. 8.—Hogs grazing on alfalfa

wet weather, do little damage. Everything considered, the results will be more satisfactory if the field is divided into two or more lots, so that the danger from overgrazing any portion of it may be reduced to the minimum. A practice commonly recommended as safe to follow, even in the Eastern States, is to limit the number of hogs per acre so that one or two cuttings of hay, depending on the section, may be secured during the season. Unless the fields are grazed down closely hogs usually will not do much rooting, but should they be inclined to root they may be prevented from doing so by ringing their noses.

Although hogs will make some gain, alfalfa pasturage alone is barely more than a maintenance ration. To get them in condition for market it is therefore necessary to feed a small quantity of grain. With this combination hogs can be made ready for market cheaper than by means of any other feed. In a large number of experiments

that have been conducted, a grain ration of 2 pounds for every 100 pounds of live weight has been found the most economical, but with a larger grain ration the gains are more rapid and the returns per acre somewhat higher. Generally speaking, the sooner a hog can be put in shape for the market the more profitable will be the returns, the more the chances of loss from cholera and other causes are reduced, and the smaller the interest on the investment. Furthermore, if the hogs are in good shape from the time they reach a weight of 200 pounds, the farmer is in a position to take advantage of the market conditions; that is, the hogs are always marketable and can be shipped when the price appears to be most satisfactory.

The carrying capacity of an acre of alfalfa depends upon the condition of the stand and varies with the locality. In the East, where the stand is more easily injured by overgrazing, it is not advisable to attempt to carry as many hogs to the acre as in the irrigated sections of the West. If grain is fed in connection with the pasture, an acre will, of course, support more hogs than if no grain is fed. Ordinarily an acre of good alfalfa in any part of the country should carry 8 to 10 hogs weighing 100 pounds each with little danger of injury to the stand. Under the most favorable conditions an acre has been known to support twice this number, but such heavy grazing is very likely to prove harmful and can not be recommended except in cases where the field is soon to be plowed.

Experiments have shown some remarkable returns from grazing hogs on alfalfa. These returns run all the way from $50 to more than $150 per acre, but they are larger than can be reasonably expected under ordinary farm conditions, since due consideration was not given to risk of loss from disease and other causes and to overhead and carrying charges. Where alfalfa can be grown successfully, good returns may be expected from hogs pastured on it if a small grain ration is fed at the same time. (Fig. 8.)

POULTRY ON ALFALFA PASTURE

All kinds of poultry relish green alfalfa, and where hens have access to a field it has a very good effect in maintaining egg production. It is best to have the field divided, so that the fowls may be changed occasionally; otherwise the constant nipping back of the shoots will be detrimental to the plants. Even under the best system of management chickens have a tendency to keep the alfalfa eaten so closely on the portion of the field nearest their houses or coops that the plants are soon killed.

ALFALFA AS A SILAGE CROP

Alfalfa is used for silage only to a limited extent. There are several reasons for this which are worthy of consideration. Tonnage is one of the factors of first importance in selecting a silage crop. To be highly satisfactory for this purpose, a crop must produce a large yield per acre. This is one—and a very good—reason why corn is so popular. Where corn can be grown successfully other silage crops have difficulty in competing with it. Where corn can not be grown successfully other crops must necessarily be considered, but

usually on the basis of the yield of green matter which they will produce. Alfalfa is outranked by corn and in many sections by the small grains and other forage crops in the yield of green matter produced at a single cutting. Under reasonably favorable conditions alfalfa can be made into hay at less expense than into silage, and the quality of forage it produces as hay is nearly equal to that produced by it as silage. The crop does not lend itself particularly well to silage making. It is somewhat difficult to cut with ordinary silage cutters and is difficult to pack properly into the silo. Furthermore, the silage that has been made from alfalfa under practical conditions has not been uniformly satisfactory. Some of it has been excellent and some has been unfit for use; that is, it has developed a bad odor and has become moldy or slimy. This happens in the case of many of the other legumes, the trouble being largely due to difficulty in packing the freshly cut material in the silo. In view of the high percentage of protein in alfalfa, special care is necessary in packing; otherwise too much air is present and putrefaction takes place instead of the proper fermentation.

Notwithstanding the unsatisfactory features in connection with the use of alfalfa as a silage crop, it is used to some extent for this purpose. When weather conditions are not favorable for the curing of hay, alfalfa may be put into the silo. Good silage can be made from partially wilted alfalfa provided it is cut fine enough by the silage cutter and is well packed in the silo. Where alfalfa is partially cured before being ensiled some external moisture may improve the silage, but experience indicates that a "washy" silage is likely to result where freshly cut alfalfa is put up while wet with rain. Furthermore, wet fields and bad weather interfere with the operations of silage making. Since the filling of a silo is usually done cooperatively by the farmer and his neighbors, it is not always possible or economical to handle partly cured hay in this manner. The filling of a silo is not as simple an operation as stacking hay or putting it in barns.

Alfalfa and corn mixed make good silage. The relatively high percentage of carbohydrates (sugar and starch) in the corn is conducive to the right kind of fermentation. For this reason mixing alfalfa with the sorghums or small grains is advantageous. The Kansas Agricultural Experiment Station found that crude molasses mixed with alfalfa improved the quality of the silage, since, like the crops just mentioned, it adds the sugar necessary for good fermentation. Preliminary experiments conducted by the United States Department of Agriculture indicate that good silage can be made by mixing alfalfa and the straw of any of the small grains, provided the mixture is made when the material passes through the silage cutter and water is added if necessary to make it pack properly.

In conclusion, alfalfa is not regarded as an ideal silage crop, and where conditions are favorable it is usually advisable to cure it for hay rather than to put it into the silo. However, it will make good silage when properly cut and packed, especially if mixed with corn or sorghums or the small grains. The feeding value of alfalfa silage is very high. With a knowledge of these facts the farmer should be able to judge for himself whether or not it will be to his advantage to put his alfalfa crop into the silo.

ALFALFA AS A SOILING CROP

Alfalfa is sometimes cut and fed green, but notwithstanding the fact that this method of handling the crop has proved highly satisfactory the practice is confined largely to the dairy farms of the northeastern quarter of the United States. The Arizona Agricultural Experiment Station estimates that by utilizing alfalfa as a soiling crop 35 acres will carry 100 steers weighing 900 pounds each through the growing season, which is about double what could be expected from pasturage. In Canada it is claimed that the cost of producing pork is reduced 25 to 50 per cent when green alfalfa is fed with grain, as compared with grain alone.

The main objection to feeding alfalfa green is the extra amount of labor involved, although this is doubtless more than offset by the increased production per acre and the better condition in which the stands are maintained as compared with pasturing. The only precaution necessary is to cut the crop no earlier and no oftener than it would be cut for hay. No cases are recorded of alfalfa causing bloat when used as a soiling crop.

ALFALFA TEA

From time to time articles have appeared in newspapers very highly recommending alfalfa tea as a feed for pigs and calves. The tea is made by pouring boiling water on the hay and allowing it to steep for a few hours or by stirring alfalfa meal into cool water and straining the mixture after it has stood several hours. In feeding, some grain is added to the tea. Several State experiment stations have conducted tests to determine the value of alfalfa tea.

The Wyoming Agricultural Experiment Station found that growing pigs receiving a grain ration consisting of one-half corn meal and one-half middlings mixed with alfalfa tea made better gains than where water replaced the tea, but the gains were hardly sufficient to justify the additional expense. In feeding alfalfa tea to calves the Kansas Agricultural Experiment Station obtained poor gains, and it seemed almost impossible to keep the calves from scouring. It appears, therefore, that about the only conclusion that can be drawn from the results of the actual experiments with alfalfa tea is that it does not give sufficiently good results to justify the extra labor involved in making and feeding it either to pigs or calves.

ALFALFA STRAW

In the production of alfalfa seed the forage feature of the crop is of secondary consideration. Attention is focused on the seed crop, and practices are followed that give the best returns in quantity and quality of seed. Therefore it frequently happens that the straw, as the stems and leaves are commonly called after the crop is threshed, is less valuable from a feeding standpoint than if an attempt were made to obtain the best forage possible without sacrificing the seed crop unduly. For example, when the crop is harvested, as soon as most of the seed pods are mature and while the plants still retain many of their green leaves, the straw is of higher feeding value than when the plants are left until the pods are entirely ripe and the leaves have fallen.

Where forage is of more concern it is better to cut the crop while the stems and leaves are somewhat green, as the increased forage value of the straw more than offsets the loss due to immature seed. If the straw is from the first crop of the season it is likely to be coarser and have fewer leaves than if it is from the second or subsequent crops. It is therefore regarded as being less palatable. In some sections farmers prefer straw from the first crop, as it is likely to contain a larger proportion of grass than the later cuttings and is thought to be of higher feeding value. Of course, in some sections the season is not long enough for more than one crop.

Opinions differ greatly with regard to alfalfa straw. Some farmers think it is better when the crop is grown under irrigation, as it contains more leaves and consequently is more valuable as a forage. There seems to be little in this contention. Some think if the crop is stacked as soon as it is harvested more leaves are retained and

FIG. 9.—Work horses feeding on alfalfa straw

the curing which takes place in the stack improves the quality of the stems. Although this may be the case, there is no definite evidence in support of it.

Again, there are some who regard alfalfa straw as practically worthless for feed, but this is probably because their experience has been confined to a very poor grade of straw or straw that had become damaged by weather after threshing. Most farmers, however, who have had considerable experience in feeding alfalfa straw estimate its value at one-third to one-half the value of good alfalfa hay, and ordinarily this is the basis upon which it sells. Its actual value depends upon the time it is cut, the manner in which it is handled, and the conditions under which it is grown.

Most of the alfalfa straw that is produced is fed to cattle, and in some cases cattle are carried through the winter on it with no supplemental feed. However, this practice is not to be recommended, for the straw, even when it is of good quality and eaten in large

quantities, is barely a maintenance ration. Calves and old cows have difficulty in chewing it properly. It is not considered very satisfactory for dairy cows. Work horses and mules do very well on alfalfa straw if a liberal supplemental grain ration is fed, but more grain is required than with alfalfa hay (fig. 9). Sheep seem to do better on alfalfa straw than any other kind of farm animals, provided their teeth are in good condition.

In threshing the alfalfa-seed crop, the stems and leaves are broken and pulverized more or less, depending upon the type of threshing machine used and whether the material is passed through the machine one or more times. Unless care is taken in feeding it considerable waste results. Feeding directly from the stack is most unsatisfactory and wasteful, as the animals soon eat all of the fine material and leave the coarse stems until the last, which usually means that these are not eaten at all. If the straw is hauled from the stack and

FIG. 10.—Cattle being fed alfalfa straw from mangers to avoid waste

fed upon the ground a loss also ensues, particularly of the fine material. The most satisfactory method is to feed the straw in tight-bottom mangers, giving only enough for one feed at a time (fig. 10). In this way the fine material is not lost and very little of the coarse straw is wasted. Some care and judgment are necessary in feeding alfalfa straw to get the best results and at the same time avoid the loss of stock. The greatest source of danger in this connection is from compaction. When straw is fed alone the animals are forced to eat large quantities to get enough nutriment to meet their requirements. Under such conditions balls composed of dirt and fine particles of straw form in their stomachs, thereby blocking the passage between the stomach and intestines and very frequently causing death. This is not so likely to occur if the animals have access to salt and water at all times or if they have grain or pasture in addition. Cattle on pasture frequently seem to relish a certain

ration of straw, but they will not eat large quantities of it unless compelled.

After all, the chief value of the alfalfa straw is that it furnishes some roughage, and the best results are secured when it is fed with a grain ration. Spoiled or moldy straw is very apt to result in derangement of the digestive tract, which sometimes proves fatal.

In times past alfalfa straw has been used very satisfactorily as a mulch in the citrus orchards of the Southwest. Its utilization for this purpose, however, is practicable only when the straw is cheap.

ALFALFA AS A GREEN MANURE, SOIL IMPROVER, AND ORCHARD COVER CROP

As a rule alfalfa is not a satisfactory green-manure crop. Like many other perennials, it is rather slow to start and does not produce tonnage quickly enough. Furthermore, in many sections it is expensive and difficult to establish. From these various standpoints there are other crops that are so much more satisfactory for this purpose that alfalfa can not compete with them.

Where alfalfa has been grown on land for a series of years in regions of abundant rainfall or under irrigation it has a beneficial effect on the succeeding crops, with the possible exception of certain legumes, but under dry-farming conditions alfalfa frequently reduces the soil moisture to such an extent as to result in decreased yields of subsequent crops.

Where irrigation water is sufficiently abundant alfalfa as a permanent or partly permanent cover crop appears to be the best crop known for correcting certain soil troubles and the physiological diseases of fruit trees resulting therefrom. Its success in the West is causing it to be tried to some extent in apple orchards in the humid Eastern States. Some orchardists make a practice of removing at least one or two hay crops each season, leaving the remaining growth on the ground. On certain soils, particularly those of light texture, the results would doubtless be more satisfactory in the long run if the entire season's growth were left to maintain or increase the productivity of the soil. The arsenical sprays that are commonly used on fruit trees make caution necessary in connection with pasturage or the feeding of hay upon which the sprays have fallen.

ALFALFA MEAL

The word meal as applied to ground or chopped alfalfa is misleading, since the material after it passes through the grinder is not of uniform consistency, but partakes more of the nature of chop than of meal. However, since the term alfalfa meal has become thoroughly established in the trade, the ground alfalfa will be referred to as meal in the succeeding pages.

There seems to be considerable uncertainty as to when and where the first alfalfa was ground into meal, but it is pretty well established that one of the first attempts to manufacture it on a commercial scale, if not the first attempt, was made at Wichita, Kans., about 1904. This attempt, although not particularly successful, attracted

attention to the possibilities of developing an industry, and during the next few years several mills sprang up in various parts of the country. Among the factors contributing to the rapid development of the industry were the increase in the popularity of concentrated feeds, the extensive advertising campaign that was being conducted in the interest of alfalfa, and the desire to find a profitable outlet from the remote districts of the West.

Most of the early mills were built in Kansas and Nebraska, but many of these failed for one reason or another, and as new plants were established the industry moved westward, where the climatic conditions were more favorable and larger supplies of alfalfa were available. To-day the largest mills are found in Wyoming, New Mexico, California, and Colorado, the last-mentioned State surpassing in the number of mills and the output of meal. There are also numerous alfalfa mills in the cities of the Middle West, but they are practically always operated in connection with mixed-feed plants and use baled hay that has been shipped in from distant points.

One of the most important factors contributing to the unprofitable operation of alfalfa mills doubtless has been the failure to give sufficiently careful consideration to their location. In the eagerness to get in on the ground floor little or no attention was given to the probable effect of the climate in reducing the output by unfavorable weather, undependable supplies of hay and labor, and inadequate shipping and market facilities. The first grinding machinery made was not dependable, and fires were of such frequent occurrence, because of sparks caused by friction or the presence of pieces of metal in the hay, that considerable difficulty was encountered in getting insurance protection; consequently, when a plant burned it was difficult to get money for rebuilding. Promoters engaged in various schemes to sell stock without having any interest in the success of the plant after its completion, no consideration being given to location or to permanency of buildings and machinery. Furthermore, most of the pioneer mills were of such limited capacity that they could not be operated at a profit. These and other reasons account for many failures.

BUILDINGS

In constructing buildings for alfalfa mills the desirable features are to have them cheap, durable, and as nearly fireproof as practicable. In most cases they are frame structures covered with corrugated sheet iron (fig. 11). The main building, which houses the machinery, is generally two or three stories high, has a cement floor, and is frequently of noninflammable material, to reduce the fire risk. For the same reason some millers express a preference for 1-story structures. Attached directly to this main building, or more commonly separated by a distance of 30 feet or more, are warehouses; usually one for receiving hay, with an average capacity of 50 to 100 tons of loose hay, and at least one for storing the meal, with a capacity ranging from a few hundred to four or five thousand tons. These structures are generally on opposite sides of the mill proper, although they are not uncommonly placed at right angles to each

other, the arrangement depending largely upon the ground that is available. The floor in the hay warehouse is usually of cement, and sometimes the floor in the warehouse for the meal is of the same material. However, there seems to be some objection to the use of a cement floor in the meal warehouses, as the moisture in the cement rots the sacks and causes spoilage if the meal is left in contact with the floor for a considerable time. Men of experience, however, contend that the cement becomes thoroughly dry after two or three years and then the objection no longer holds. Spoilage from moist cement may be obviated by covering the floor with planks, but this of course increases the cost and fire risk. In addition to the buildings described above, there is nearly always a small building for the office and scales.

MACHINERY

The essential machinery in a well-equipped mill consists of an electric motor, a steam or gasoline engine, a bale breaker, a grinder or pulverizer, screens, blowers, packers, cyclones, and other dust

FIG. 11.—A typical alfalfa meal mill

collectors, wagons, conveyors, and scales. In addition, mills making mixed feeds are equipped with automatic feeders, sirup tanks, and mixing vats.

The power used in operating the mill depends largely upon what is available. In sections where electricity may be had most mills have two electric motors, one of 150 to 300 horsepower for running the grinder and another of 50 horsepower for running the fans and packers. Where electric power is not available steam or gasoline engines are used. Some millers who have both steam and electric power are of the opinion that steam power is cheaper, but the electric power is more convenient and involves less fire risk.

Mills that handle baled hay are equipped with bale breakers for breaking the bales apart before they are fed into the grinder.

Grinders or pulverizers are of various advertised capacities up to 12 tons an hour, but this high capacity is possible only under the most favorable conditions. In actual practice it is seldom safe to count on more than half the advertised capacity. The moisture content of the hay is very largely the determining factor. Strength is one of the

prime requisites for a grinder, as the machinery is subject to a great strain, particularly when the hay is tough.

Grinders are made with two distinct objects in mind—one to reduce the alfalfa to small particles by breaking or grinding and the other to reduce it by cutting. The advantage claimed for the cutting machines is that the hay may be handled with more moisture and that the resulting meal is practically free from the dust that is objectionable from a feeding standpoint. However, most of the mills now in use depend upon the grinding or pulverizing principle. These mills are of four general types. One type consists of a large number of swinging steel hammers, which are fastened to plates of steel with three or four arms, each arm bearing a swinging hammer. The steel plates are fastened firmly to a revolving shaft (fig. 12). A modification of this type of machine consists of a series of heavy steel plates with two or four arms which are attached to a revolving shaft but have no swinging-hammer feature (fig. 13).

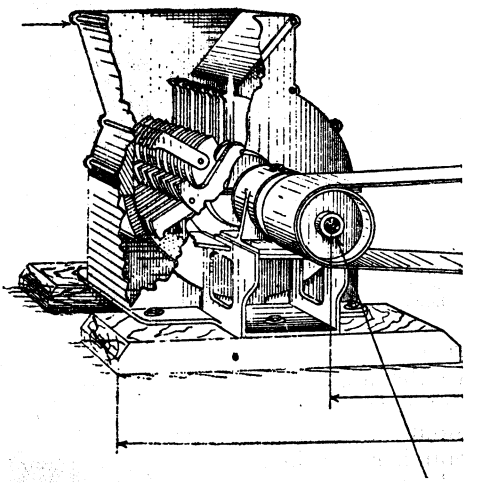

FIG. 12.—The swinging-hammer type of alfalfa grinder

Another type of grinder has one or two series of hooked knives which partially cut the hay and force it into the main chamber, where it is further reduced by means of sharp-cornered steel pegs fastened to a rapidly revolving hollow drum (fig. 14).

One type of grinder is constructed on somewhat the same principle as a thresher, but with the part that corresponds to the cylinder in several sections instead of in one piece. The teeth are much closer together, and all parts are necessarily greatly strengthened (fig. 15).

One of the machines that reduces the hay to meal by cutting works on practically the same principle as the ordinary silage cutter but has a special attachment for reducing the meal to a finer consistency (fig. 16).

All grinders are equipped with perforated steel plates or wire screens through which the meal passes when it becomes sufficiently fine. The size of these perforations or the mesh of the screens determines the fineness of the product (fig. 17).

The blowers are large metal fans that produce the draft of air for conveying the meal from the grinders to the cyclones (fig. 18).

The cyclones (fig. 19) are hollow cones made of galvanized sheet iron and are located in the upper story of the higher buildings or, where the building has only one story, project through the roof. The purpose of these cyclones is to check the blast of air carrying the meal. The meal then drops through a galvanized tube to the packers.

A few mills are equipped with automatic dust collectors, and while these do catch the finest particles of meal that are seen escaping as a green dust from the cyclones they apparently increase the fire risk, and for that reason most of the alfalfa mills do not have them.

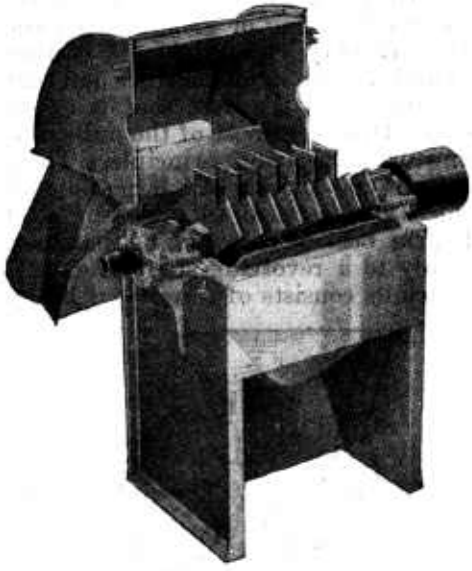

FIG. 13.—A machine for pulverizing alfalfa by means of square-cornered steel plates on a horizontal shaft.

Packers are used for packing the meal into sacks. There are several makes on the market, all employing the same general principle. The meal is carried into the sack through a tube and is packed by means of a slowly revolving auger (fig. 20).

The conveyors are of the usual type of construction. Each well-equipped grinding plant has two sets—one for conveying the hay to the grinder and the other for conveying the sacked meal from the packers.

Most of the commercial mills which depend on the local supply of hay have several wagons and hayracks for hauling the alfalfa from the field to the mill, the number ranging from about 20 for a mill with a capacity of 4 tons per hour to double that number for the larger plants.

Other equipment consists of wagon scales for weighing the hay as it comes into the mill and small scales for weighing the bagged meal.

Automatic feeders are used in plants that put out mixed feeds. They are so constructed that the grain and alfalfa meal are weighed automatically as they pass from the storage bins to the mixing vat. The feeders can be adjusted to deliver the various grains and meal in almost any proportion desired (fig. 21).

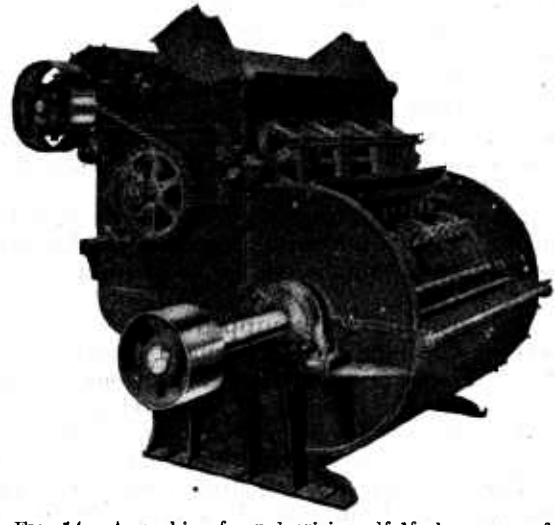

FIG. 14.—A machine for pulverizing alfalfa by means of a series of square steel pegs attached to a drum

Large quantities of molasses are used in the alfalfa-mixed feeds, and a storage capacity of several hundred gallons is required. The

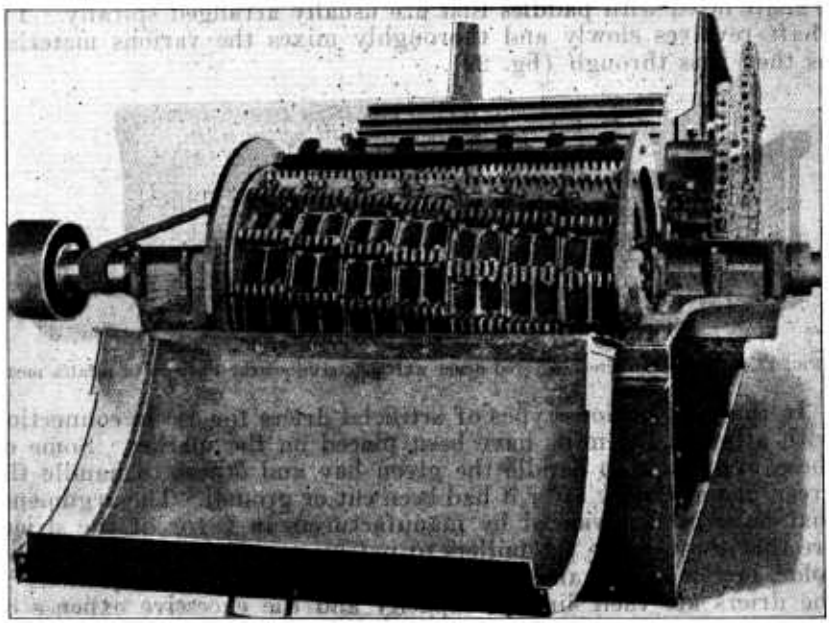

FIG. 15.—An alfalfa grinder with teeth arranged on a cylinder and concave similar to the ordinary thresher

tanks used for this purpose are usually of galvanized sheet iron and are placed under or outside the building. From these tanks the sirup is pumped to a smaller vat filled with a steam-pipe coil for heating

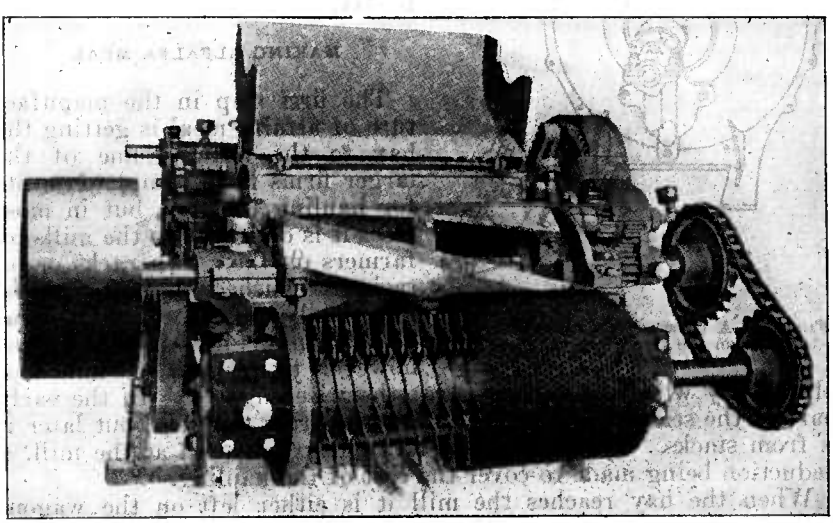

FIG. 16.—An alfalfa grinder in which the common feed-cutter principle is employed

it to such a temperature that it will mix readily with the alfalfa meal and other materials.

The mixer is a long galvanized sheet-iron vat through which runs a shaft fitted with paddles that are usually arranged spirally. The shaft revolves slowly and thoroughly mixes the various materials as they pass through (fig. 22).

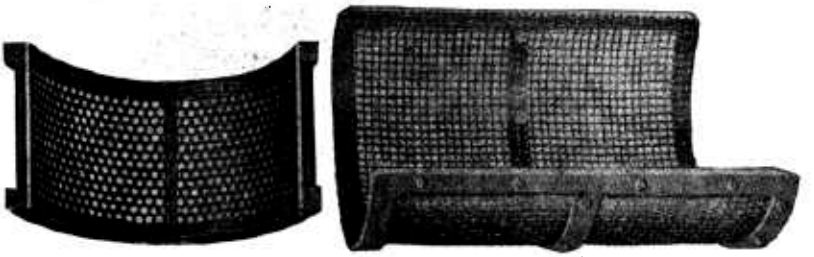

FIG. 17.—Parts of a screen-covered drum which determines the fineness of alfalfa meal

In the past, various types of artificial driers for use in connection with alfalfa-meal mills have been placed on the market. Some of these were built to handle the green hay and others to handle the green material only after it had been cut or ground. The arguments that have been advanced by manufacturers in favor of the driers are that they enable the millers to put up an alfalfa meal of better color, better aroma, and a higher feeding value. The objections to the driers are their limited capacity and the excessive expense of operation, for which the market seems unwilling to pay. That artificial driers have not proved economical up to the present time is attested by the fact that practically none of them are in use to-day.

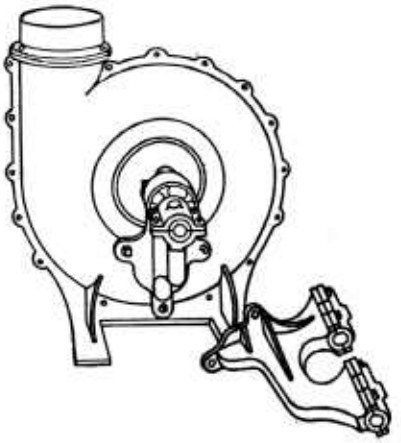

FIG. 18.—A blower for conveying alfalfa meal from the grinder to the cyclone

MAKING ALFALFA MEAL

The first step in the manufacture of alfalfa meal is getting the hay to the mill. Some of the larger firms have complete outfits for hauling the hay, but in most cases it is delivered to the mills by farmers on their own racks or on racks furnished by the mills. Practically all the commercial firms own or hire a few teams, however, to insure a constant supply of hay when the farmers are otherwise engaged. In the early part of the season most of the hauling is from the field, but later it is from stacks. The basic price is for hay delivered at the mill, a deduction being made to cover the cost of the hauling.

When the hay reaches the mill it is either left on the wagons (fig. 23) until needed or is thrown into the storage shed. In parts of California where there is little danger of rain during the grinding

season the hay is thrown in great piles outside the mills (fig. 24). From the wagons, storage shed, or piles the hay is thrown on the conveyor and carried to the grinder. The percentage of moisture in the hay when it goes to the grinder is, of course, quite variable, depending upon weather conditions and the length of time since harvesting. Ordinarily the moisture should not exceed 12 per cent, and under favorable conditions it may fall considerably lower.

The meal is taken from the grinder by suction produced by a fan and forced through a long galvanized tube to the cyclones. From the cyclones it goes to the packers, where it is put up in 100-pound bags. After weighing, the bagged meal is loaded directly on the car or is thrown on a conveyor which carries it to the warehouse, where it remains until marketed. If the warehouse is dry and the hay thoroughly cured before grinding, there is little danger of spoilage, although losses occasionally occur when the material is shipped to damp climates.

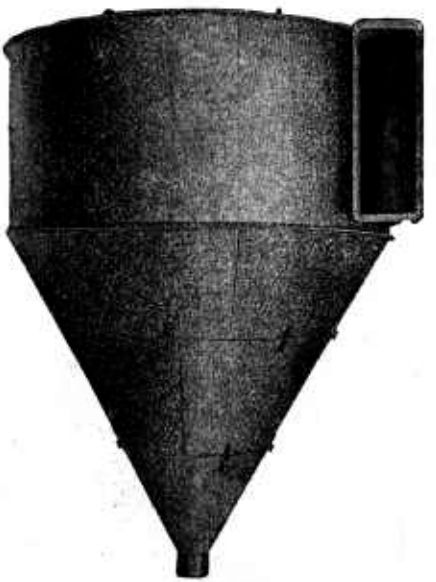

FIG. 19.—A common type of cyclone dust collector

The labor required for the different operations varies, but ordinarily a mill with a capacity of 4 to 5 tons of hay an hour will require 10 to 12 men.

The average grinding plant operates about eight months or during what is commonly spoken of as the alfalfa season. Operations start in July, August, or September, depending somewhat upon the season and the quantity of hay available, and continue until March, April, or May, when ordinarily the supply of hay is exhausted. Mills located at the big terminals, such as Kansas City and Omaha, which depend on baled hay for grinding, operate as a rule throughout the year.

The market recognizes about the same grades of meal as of hay; in fact, the grade of meal is determined largely by the grade of hay from which it is made. Aroma and color are two important factors in classifying meal, but unfortunately they do not always give a true index of its feeding value. For instance, there is considerable difference in the feeding value of meal made from hay that has browned in the stack and that made from hay that has browned by being exposed to unfavorable weather conditions, and yet if both have a good aroma they are sold on the market under the same grade. In addition to the grades that are determined by aroma and color, there are other grades that are determined by the fineness of the material. The finer grades cost more to manufacture and bring a somewhat higher price. The finely ground meal is intended for special purposes, such as poultry and hog feed, and ordinarily only the best hay is used in making it. (Figs. 25 and 26.) Alfalfa straw is ground into meal to a

limited extent, but it is apparent that such meal is not as good a feed as meal made from good alfalfa hay.

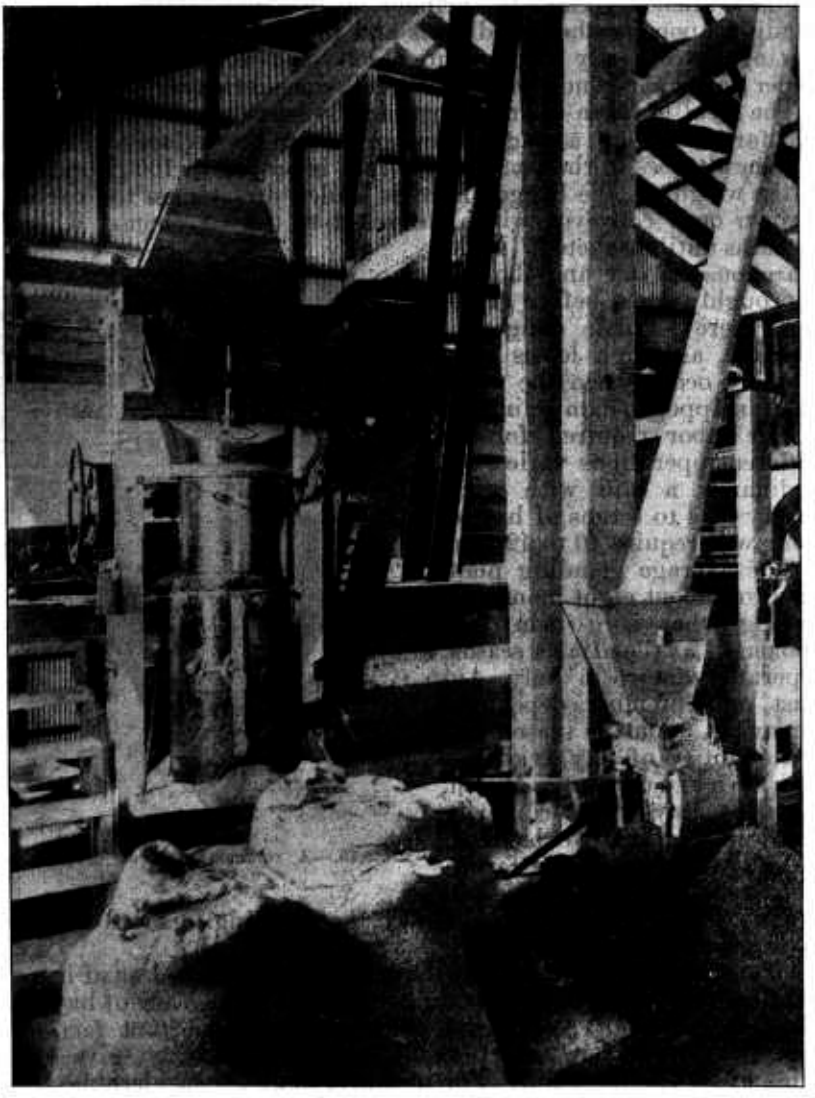

FIG. 20.—A common type of packer or bag filler, as used in an alfalfa-meal mill

PORTABLE MILLS

In the beginning of the alfalfa-meal industry most of the mills were of the portable type (fig. 27), but they have for the most part been discarded or converted into stationary mills. However, there is still an occasional demand for portable mills from the drier parts of the extreme West, particularly from California, where they seem to be operating with some success.

The general failure of the portable mill is attributed to its limited capacity, the inability of tractor engines to furnish sufficient power, and the necessity for ceasing operations whenever a wind or rain storm occurs, all of which tends greatly to increase the cost of grinding.

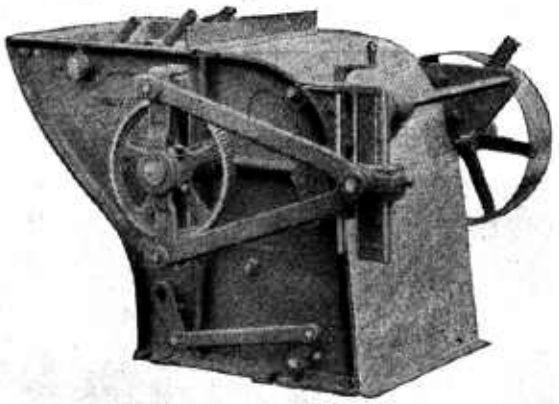

FIG. 21.—An automatic feeder used in plants putting out alfalfa mixed feeds

INDIVIDUAL MILLS

Several big sheepmen and cattle feeders of Colorado have installed small plants for grinding hay and mixing the meal with molasses for home use. The cattle or sheep are taken from the ranges in the fall and fed alfalfa meal and grain until ready for the market. The cost of grinding is reduced to a minimum by being done when work is slack, and it is quite possible that the reduced wastage in feeding will pay this expense, but the extravagant profits claimed by some of these feeders are not substantiated by actual feeding tests.

FACTORS TO BE CONSIDERED IN CONNECTION WITH THE BUILDING OF A GRINDING PLANT

There are several important factors that should be carefully considered by a prospective entrant into the alfalfa-meal industry, such

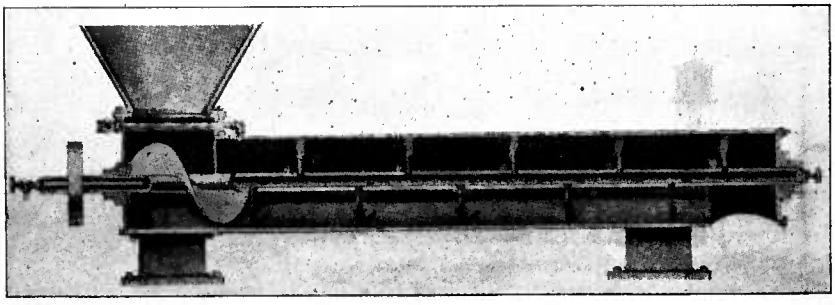

FIG. 22.—An alfalfa feed mixer

as the cost of the plant, the availability of hay, shipping facilities and market for the meal, the availability of labor, and the climatic conditions.

The cost of the plant is, of course, subject to wide variations, depending upon the capacity and the character of the buildings and machinery. In the long run substantial buildings that are as nearly fireproof as practicable and durable machinery will be found the

most economical. To build a satisfactory commercial mill under normal conditions there should be available a capital of $15,000 to $40,000.

One of the important factors in the success of the alfalfa-meal industry is a readily available supply of good hay at a relatively low

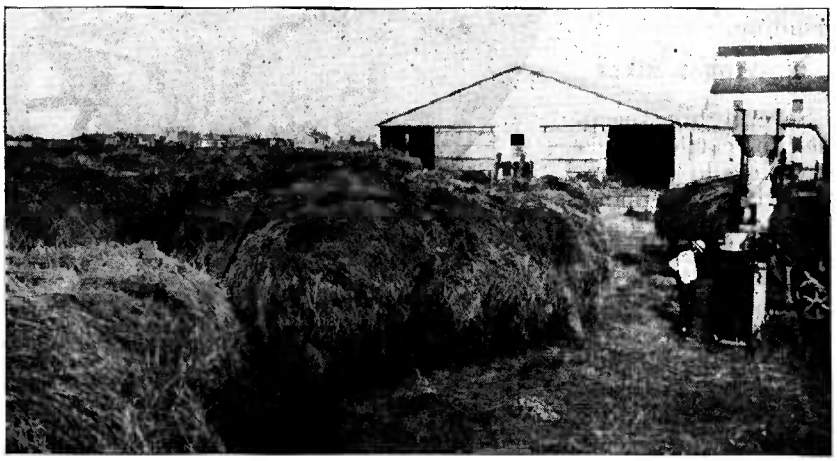

FIG. 23.—Hay wagons loaded with alfalfa waiting to be ground

price. For this reason most of the successful mills that manufacture only straight meal are located in the big alfalfa districts and depend upon being able to procure hay within easy hauling distance, which ordinarily does not exceed 5 miles. The quantity of hay required depends upon the capacity of the mill. Ordinarily a 2-ton mill will require 4,000 to 5,000 tons for the operating season. Where the local supply is not sufficient, baled hay may be shipped in and ground,

FIG. 24.—Alfalfa in piles outside the meal mill

then forwarded to destination, the miller paying a through rate from the point of origin to the point where the sale is made. This increases somewhat the cost of producing meal. It is almost essential that the mill be located on a railroad for convenience in shipping and to eliminate charges for hauling.

Careful consideration should be given to the probable market for the product and also to the comparative prices of hay and meal to determine so far as possible whether the difference will leave a profit after deducting the cost of manufacturing and shipping.

The possibility of obtaining sufficient labor at a wage that will still leave a profit for the manufacturer should be definitely determined. In considering this item one should not lose sight of the fact that mills are not infrequently compelled to shut down for repairs and adjustments. This, of course, adds to the cost of the manufacture of the meal, since the men are paid just the same as when the mill is operating. Other factors that should be considered

FIG. 25.—Alfalfa meal of the usual degree of fineness

in this connection are the salaries of salesmen and officers of the company, if any, and other items of overhead expense.

The relation of climate to the making of alfalfa meal is a factor of great importance. Unfavorable weather increases the cost of manufacture by reducing the capacity of the mill and increasing the proportion of spoiled hay. For these reasons the drier sections of the country are best suited to the industry, and it is there that most of the big commercial plants are located.

There are numerous other items of cost that enter into the manufacture of alfalfa meal. Some of them, such as power charges, cost of sacks, and interest on the investment, can be calculated with a

considerable degree of accuracy, but other items, such as repairs, losses of various kinds incident to the purchase and storage of hay and to the manufacture, storage, and sale of the meal, can only be determined after a season's run.

FEEDING ALFALFA MEAL

Various experiments have been made with alfalfa meal to determine its value for different kinds of livestock. These experiments have been conducted along two lines, one to determine the economy of feeding alfalfa meal as compared with alfalfa hay and the other

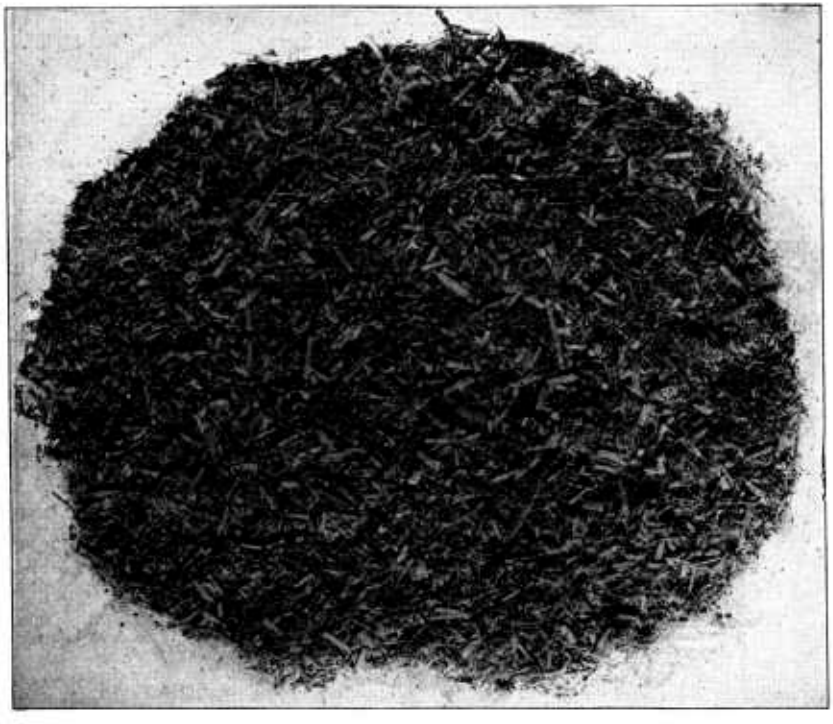

FIG. 26.—Finely ground alfalfa meal

to determine its value in replacing high-priced concentrates, particularly wheat bran.

In experiments comparing the value of alfalfa meal and wheat bran the State Agricultural Experiment Stations of Vermont, Massachusetts, and Pennsylvania have reached the same general conclusion—that alfalfa meal is slightly inferior to wheat bran for milk production. The results at the Nebraska Agricultural Experiment Station, on the other hand, indicated that the meal is fully equal to wheat bran. The former gave a slightly lower production of milk and butterfat, but this was overcome by the gain in weight.

In feeding swine the Wyoming Agricultural Experiment Station found that alfalfa meal gave decidedly poorer results than mid-

dlings when fed with a corn ration, while the Colorado station concluded that although shorts and corn gave more rapid gains than alfalfa meal and corn, the latter was so much more economical that a farmer could afford to feed somewhat longer. In comparing alfalfa meal with alfalfa hay in a ration for fattening hogs the Nebraska Agricultural Experiment Station concluded as the result of experiments covering five years that alfalfa was fed more satisfactorily without cutting or grinding. The gains were more rapid and cheaper where the hay was fed from the racks. The Colorado and Kansas stations also found that in feeding hogs the grinding of alfalfa hay into meal did not increase its value sufficiently to pay for the extra expense. The New Jersey Agricultural Experiment Station found that alfalfa meal as compared with alfalfa hay in a ration for brood sows considerably reduced the cost of maintenance.

FIG. 27.—A portable alfalfa-meal mill

During the winter months, when no green succulent feed is available, poultry apparently utilize a small mixture of alfalfa meal in their daily mash to good advantage, but this does not take the place of succulent green feed.

The mere grinding of alfalfa hay does not materially alter its composition, and that it has little effect on its feeding value is indicated by the results cited above. The advantages of the meal are that it is fed with less waste than hay and is in a convenient form, especially for use in towns and cities. There is also a considerable reduction on freight charges when shipped for long distances.

ALFALFA MIXED FEEDS

The mixed-feed industry has made wonderful strides during the past few years, and attempts have been made to utilize everything that has any possibility as a feed, including the by-products

from the flour and feed mills and elevators. In the search for constituents for these various mixtures, alfalfa meal has come to occupy an important place, partly owing to the fact that it is high in protein and can be used to advantage to balance the feed and partly because it is cheaper than most other protein feeds. The firms putting out mixed feeds containing alfalfa meal are very numerous, and nearly all of them put out several such feeds, the number in one instance running as high as 37.

The simplest mixture, and one that is quite extensively used for both horses and cattle, consists of alfalfa meal and molasses, the proportion of molasses ranging all the way from 15 to 40 per cent. The original purpose of the molasses was to prevent the loss of the fine material through the sack and to keep down the dust, which is objectionable in feeding horses and sheep. Both cane and beet sirup are used for mixing with alfalfa meal. The cane sirup is sweeter and seems to be more palatable, but the beet sirup carries a higher percentage of mineral matter, which some feeders consider an advantage, especially for the cattle. The cane sirup has a tendency to darken the product more than beet sirup, so that it does not present quite as good an appearance on the market.

The concentrates used in the alfalfa-meal mixtures are about the same as those found in other mixed feeds destined for the same purpose, such as corn, oats, barley, and molasses for horses and fattening cattle, and wheat bran, cottonseed meal, corn, and barley for dairy cows. Ordinarily only the very finely ground alfalfa meal goes into the hog and chicken feeds, which contain, in addition, the usual ingredients, such as corn, oil meal, wheat, meat meal, and middlings.

Recently attempts have been made to place alfalfa mixed feeds on the market in the form of pressed cakes of various dimensions, the advantages claimed being greater convenience in handling and reduced shipping charges.

Unfortunately, the chemical analyses of these mixed feeds are not a fair criterion of their feeding value, and therefore much depends upon the honesty of the manufacturer and his desire to establish a reputable business by giving his customers true value for their money. Reliable firms use only high-grade materials, their policy being to use only ingredients that in themselves are palatable feeds, while other firms depend largely on the poorer quality of grain, alfalfa meal, and by-products from mills and elevators.

FAKE AND FAD ALFALFA PRODUCTS

The general recognition of the high value of alfalfa as a forage crop and the extensive advertising that has been conducted in its behalf have produced attempts to extend its use to the making of human food, medicines, textiles, dyes, and other commercial products. These attempts have, for the most part, been made either with fraudulent intent or with unwise enthusiasm. Included in the list are alfalfa flour, confections, table sirups, soda-fountain sirups, flavoring extracts, tea and coffee substitutes, medicines, and fabrics. Alfalfa flour for the making of bread, cakes, and muffins does not compare at all favorably with the cereal flours or meals, and at best it must have large proportions of other flours mixed with it before it can be used in baking. As a constituent of confections and for the

making of table and soda-fountain sirups, flavoring extracts, and tea and coffee substitutes alfalfa has nothing to commend it. So far as is known it possesses no special medicinal properties, and its fiber is not commercially usable. Frequently rumors have become current that alfalfa seed is used in the making of dyes, but careful investigations have so far failed to disclose any foundation for such statements. The only legitimate use for alfalfa seed so far as is known is for seeding purposes. The readers of this bulletin are urged not to waste their money on alfalfa products like those mentioned in this paragraph.

PUBLICATIONS RECOMMENDED FOR REFERENCE IN CONNECTION WITH THIS BULLETIN

The following publications regarding the subjects treated in this bulletin will be sent free of charge upon application to the Department of Agriculture, Washington, D. C.:

Farmers' Bulletins:

636. The Chalcis-Fly in Alfalfa Seed.
677. Growing Hay in the South for Market.
757. Commercial Varieties of Alfalfa.
865. Irrigation of Alfalfa.
943. Haymaking.
944. Controlling the Garden Webworm in Alfalfa Fields.
977. Hay Caps.
982. Control of the Green Clover Worm in Alfalfa Fields.
987. Labor-Saving Practices in Haymaking.
1021. Alfalfa on Corn-Belt Farms.
1049. Baling Hay.
1094. The Alfalfa Caterpillar.
1185. Spraying for the Alfalfa Weevil.
1283. How to Grow Alfalfa.

Department Bulletins:

578. A Study of Haymaking Crews and Labor Costs.
1087. Alfalfa Root Studies.
1190. Effect of Feeding Green Alfalfa and Green Corn on Flavor and Odor of Milk.

Department Circular:

297. The Eelworm Disease; a Menace to Alfalfa in America.

○